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How can the financial sector contribute to limiting biodiversity loss? A systematic review

Lisa Junge, Yu-Shan Lin Feuer and Remmer Sassen
TU Dresden International Institute Zittau, Zittau, Germany

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Abstract

Purpose – Biodiversity loss has reached unprecedented levels, threatening the stability of economic and financial systems worldwide. The aim of this study is to synthesise existing research on biodiversity and finance and to clarify how the financial sector can engage with biodiversity and contribute to addressing its decline.

Design/methodology/approach – A systematic literature review is conducted to identify ways in which the financial sector can contribute to mitigating biodiversity loss.

Findings – Three key pathways for the financial sector to support biodiversity are identified: (1) raising awareness of biodiversity within financial institutions (FIs) and across interconnected business sectors, (2) pursuing biodiversity-related business opportunities and (3) increasing biodiversity visibility through reporting. These findings emphasise the considerable influence of the sector in shaping biodiversity outcomes as well as the need for further research into institutional practices and the impact of stakeholder engagement.

Originality/value – This study is among the first to provide a systematic synthesis of the fragmented literature on finance and biodiversity. By structuring the sector's contributions into three key pathways, it provides a conceptual foundation for future empirical research. Future studies can focus on how FIs can operationalise biodiversity considerations and further foster biodiversity conservation and restoration.

Keywords Biodiversity, Biodiversity finance, Financial sector, Financial institutions,
Systematic literature review

Paper type Literature review

1. Introduction

Biodiversity, which encapsulates diversity among genes, species and ecosystems (CBD, 1992), is critical to human well-being and the functioning of economies. It underpins the provision of ecosystem services (Millennium Ecosystem Assessment, 2005), such as food, water, energy and natural resources that act as critical inputs into economic systems and value creation (Costanza *et al.*, 1997, 2014; Diaz *et al.*, 2006; Naeem *et al.*, 2016). This relationship gains additional relevance in light of the planetary boundaries framework, which identifies biosphere integrity alongside climate change as a core boundary (Rockström *et al.*, 2009). Studies indicate that both core boundaries have already been transgressed, increasing the risk of abrupt and irreversible environmental shifts with severe implications for socio-economic systems (Pascual *et al.*, 2022; Richardson *et al.*, 2023; Steffen *et al.*, 2015). Despite its systemic significance, biodiversity loss has remained underrepresented in the academic discourse compared to climate change (Williams *et al.*, 2024).

The continued loss of biodiversity creates an existential threat, risking global economic stability and human welfare (Costanza *et al.*, 2014; Dasgupta, 2021; Diaz *et al.*, 2006; Roe *et al.*, 2019; World Economic Forum, 2025). The socio-economic risks of biodiversity loss, ranging from disrupted supply chains to macro-level financial instability, are well documented (Dasgupta, 2021; Pascual *et al.*, 2022; World Economic Forum, 2020). Public-sector conservation efforts alone are insufficient to halt or reverse the ongoing trend of decline (Bull and Brownlie, 2017; Leadley *et al.*, 2022). This places greater responsibility on the private sector and particularly on the financial sector (CBD, 2022; Potdar *et al.*, 2016), as it is capable of redirecting financial flows (Chabrak, 2018) and steering economic development (Network for Greening the Financial Sector (NGFS), 2021; Vazzano *et al.*, 2018).

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Increasingly, the financial sector's pivotal role in shaping biodiversity outcomes is being highlighted. The UN Decade on Biodiversity further initiated efforts to engage private actors (CBD, 2012; OECD, 2019). However, many FIs continue to finance high-biodiversity-impact sectors such as conventional agriculture and extractive industries (Bigger *et al.*, 2021; Loorbach *et al.*, 2020; Portfolio Earth, 2020). Biodiversity actions by the financial sector can be derived through direct operations and via capital allocation and investment practices (Buteica and Huidumac-Petrescu, 2019; CBD, 2022; Chabrak, 2018). FIs have yet to integrate biodiversity into their risk management and disclosure strategies (Bigger *et al.*, 2021; Schellekens and van Toor, 2019; de Silva *et al.*, 2019; van Toor *et al.*, 2020). Empirical analyses, such as the study by Azizi *et al.* (2025), indicate that FIs' biodiversity disclosure is beginning to emerge, primarily driven by regulatory pressures. Yet biodiversity reporting remains in its infancy despite significant asset exposure to ecosystem service dependencies (Mundaca and Heintze, 2024). Overall, research on the financial sector's role in biodiversity remains scattered and lacks systematisation.

This research paper aims to organise existing literature on the relationship between the financial sector and biodiversity through a systematic review, asking: "How can the financial sector contribute to limiting biodiversity loss?". The goal is to identify key pathways that the financial sector can implement to help reduce and reverse biodiversity degradation. To date, the authors are not aware of any such systematic review that integrates both academic and grey literature. This review aims to provide a common ground for future research and to inform the transformative changes necessary to protect biodiversity.

The structure of the study is as follows. Section 2 conceptualises the intricate relationship between the financial sector and biodiversity. Section 3 outlines the method applied in conducting a systematic literature review. Section 4 presents the key findings, which are discussed in Section 5. Section 6 concludes by synthesising the main insights and implications.

2. Conceptualising the financial sector–biodiversity nexus

After the 2008 world financial crisis, increasing resilience among economic actors by implementing sustainability into the finance system became a central objective to prevent further breakdowns (Ziolo *et al.*, 2019). Consequently, the overall greening of the financial system has gained substantial traction in both academic research and political discourse (Chabrak, 2018; EU Technical Expert Group on Sustainable Finance, 2020; Nedopil *et al.*, 2021; Wei and Xiao, 2020). To date, most research is scattered or focuses on environmental niche topics, which often do not specifically address biodiversity (Clark *et al.*, 2018; Mulder and Koellner, 2011; Yu *et al.*, 2021). This creates an obstacle to reaching sustainable development (Smith *et al.*, 2020).

Growing evidence suggests that the financial sector plays an integral role in the degradation of biodiversity through contemporary business practices, frequently generating negative externalities that FIs do not yet factor in (Buteica and Huidumac-Petrescu, 2019; Chabrak, 2018). FIs have a direct influence on biodiversity through their daily business operations (e.g. real estate, waste production, energy and paper consumption), which are interconnected with the direct drivers of biodiversity loss (IPBES, 2019; Mulder and Koellner, 2011). As intermediaries of global capital flows, FIs shape biodiversity outcomes primarily indirectly through their business activities and strategic orientations (Chabrak, 2018; Krause *et al.*, 2021; Mulder and Koellner, 2011; Vazzano *et al.*, 2018). Consequently, FIs' business success depends on how business partners tackle biodiversity-related impacts and dependencies, rendering biodiversity an essential risk-management topic for FIs to avoid sudden and unexpected contract defaults (Bhattacharya and Managi, 2013). Overlooking biodiversity and its loss in FIs' decision-making could create a multitude of risks (e.g. liability and reputational risks) and real costs associated with increased credit defaults as well as reductions in shareholder value (Mulder and Koellner, 2011).

The current lack of biodiversity recognition by FIs is shown by Krause *et al.* (2021). The study illustrates that despite holding substantial leverage to promote biodiversity-positive outcomes, FIs have yet to systematically integrate biodiversity considerations into their strategic interactions with investees and other business partners (Krause *et al.*, 2021). This finding is reinforced by de Silva *et al.* (2019), who investigate corporate biodiversity-related commitments and show that although 90 FIs signed the Equator Principles to commit to reducing negative biodiversity impacts of investments, none have yet aligned these with their lending strategies. Ziolo *et al.* (2019) further argue that despite FIs' potential to drive sustainability, they insufficiently address environmental issues and particularly biodiversity, compared to social and governance factors. Nevertheless, various investigations already predict existential risks to livelihoods, living standards and overall economic functioning if biodiversity loss continues (Mace *et al.*, 2018; Dasgupta, 2021; Pascual *et al.*, 2022; World Economic Forum, 2020; World Economic Forum, 2021), thereby also jeopardising global financial systems (CISL, 2021; Potdar *et al.*, 2016; World Wildlife Fund, 2021).

FIs possess leverage in the economy, engaging directly with a diverse range of business sectors through activities such as lending, underwriting, insurance and other financial services (EU Technical Expert Group on Sustainable Finance, 2020; Krause *et al.*, 2021; Mejia-Escobar *et al.*, 2020). This influence enables FIs to steer future investments towards more sustainable practices (NGFS, 2021) and to pioneer innovative financial strategies and practices (Krause *et al.*, 2021). Despite the importance of the financial sector's impact on biodiversity, this issue often becomes secondary to climate change in sustainability discussions (Bigger *et al.*, 2021; Loorbach *et al.*, 2020), although both crises are closely interconnected (IPBES, 2019; Pascual *et al.*, 2022; Shin *et al.*, 2022).

The existing literature underscores the need for the financial sector to acknowledge its dependencies on and impacts upon biodiversity. This is crucial to mitigating adverse effects and establishing a financial system that decouples economic growth from environmental degradation (Mejia-Escobar *et al.*, 2020). Although various sustainability-related frameworks have emerged within the financial domain, including sustainable finance (Świeszczak, 2020; Wilson, 2010) and green finance (Nedopil *et al.*, 2021; Yu *et al.*, 2021), a comprehensive integration of biodiversity considerations remains absent.

3. Methods

In line with the recommendations of Webster and Watson (2002) for conducting a systematic literature review in an emerging field such as biodiversity in the financial sector, the review is designed to explore existing concepts. The review will synthesise current scientific discourse using a rigorous, concept-centric design.

3.1 Scoping and research period

Webster and Watson (2002) recommend conducting a preliminary scoping study. An initial Google Scholar search was conducted to identify relevant literature on the topic. The scoping study focused on three key terms: (1) financial sector, (2) biodiversity loss and (3) transformative change.

The scoping study identifies a twofold set of relevant keywords. First, terms associated with biodiversity, including "biodiversity", "biological diversity" and "transformative change", emerge prominently. Studies by McElwee *et al.* (2020) and Turnhout *et al.* (2021) examine the financial sector's role in facilitating transformative change to counteract biodiversity decline. Transformative change is inherently linked to biological diversity and efforts to mitigate its loss. Secondly, the concept of ecosystem services, as outlined in the Millennium Ecosystem Assessment (2005), enriches the set of keywords. The ongoing biodiversity decline is reflected in terms such as "extinction crisis" (Atkins and Macpherson,

2019) and "biodiversity loss" (Kedward *et al.*, 2020). Lastly, the inclusion of "biodiversity risk" reflects the recurring theme of risk throughout the scoping study.

The second set of keywords addresses the financial sector, including various synonyms, like the finance and banking sectors. Three central reports identified during the scoping study reveal these keywords (Barker *et al.*, 2020; Bigger *et al.*, 2021; Loorbach *et al.*, 2020). Moreover, alternative finance approaches such as blended finance (Christiansen, 2021), green finance (Turnhout *et al.*, 2021) and sustainable finance (Świeszczak, 2020) enrich this second set of keywords. Table 1 provides an overview of all relevant key terms that form the basis for the literature search string.

Before initiating the literature search, a reasonable publication period for the review is selected to ensure a meaningful analysis. The period spans from 2010 to 2021, with later references used solely for better illustration. Therefore, it is important to note that this literature review is not fully comprehensive. The following reasoning guides the selection of the period under review:

(1) Between 2010 and 2020, the United Nations (UN) Decade on Biodiversity (CBD, 2012) and the Convention on Biological Diversity (CBD) Strategic Plan for Biodiversity 2011–2020, including the Aichi Biodiversity Targets, were in force. As the CBD's plan aimed to "liv[e] in harmony with nature" (CBD, 2010, p. 6), it is reasonable to investigate the current progress made on reaching this goal from the perspective of the financial sector.

(2) As of 2021, the CBD's Strategic Plan for Biodiversity has seen limited implementation, with most of the Aichi Biodiversity Targets remaining unmet (Milner-Gulland *et al.*, 2021; Tobin-de la Puente and Mitchell, 2021; Turnhout *et al.*, 2021). Therefore, including 2021 is reasonable, as some authors may have responded to the limited success of the plan and targets and the upcoming post-2020 biodiversity framework negotiations.

3.2 Systematic literature retrieval and review

To ensure systematic retrieval of literature, a search string is constructed using the two sets of identified keywords (see Table 1). Within each keyword set, related terms are linked by the Boolean operator "OR". Truncation is applied to selected keywords (e.g. "extinction cris*" and "financ* sector") to include various derivations with shared word stems, thereby enhancing retrieval efficiency. Moreover, the Boolean operator "AND" combines the two sets of keywords to ensure the search scans for both keyword sets simultaneously. The analysis is limited to English-language publications, and the keywords are defined accordingly.

The search string applies to the following databases:

Table 1. Keywords literature review

Keyword set 1	Keyword set 2
- Biodiversity - Biological diversity - Biodiversity loss - Ecosystem services - Extinction cris* - Transformative chang* - Biodiversity risk	- Bank* sector - Blended finance - Financ* sector - Green finance - Sustainable finance

Source(s): Authors' own work

(1) Web of Science (covering roughly 17,000 high-impact journals)

(2) Scopus (nearly 6,000 journals from environmental sciences and business management)

(3) Emerald Insights (covering 300 journals from various research fields)

These databases encompass a wide array of interdisciplinary academic studies and serve as valuable resources for sourcing scientific publications. The Web of Science search applies the biodiversity keywords to all rubrics and the financial sector keywords to the topic. The Scopus search uses both search string elements to the title, abstract and keywords. The Emerald Insight search applies biodiversity keywords to the title, finance-related keywords to the abstract and author-supplied abstract. For the initial stage, only peer-reviewed journal articles are included. The PRISMA (Preferred Reporting Items for Systematic reviews and Meta-Analyses) flow chart (see Figure 1) presents the complete procedure for literature retrieval.

Overall, 210 hits return from the search. After screening for duplications, 165 hits remain. Furthermore, two exclusion criteria (see Figure 1, Criterion 1 and 2 on the left-hand side) are applied to ensure the quality of the included studies, namely:

(1) Records addressing the financial sector's environmental impact in a broad sense are excluded, as they are too vague to address biodiversity specifically (Mulder and Koellner, 2011).

(2) Records that focus solely on biodiversity or on the financial sector alone are excluded from the literature pool.

After applying the above-mentioned exclusion criteria, 41 hits remain. Ultimately, 30 resources remain in the literature pool after checking for accessibility.

To enhance the literature pool, relevant grey literature and literature identified through the snowballing method are added (see Figure 1, right-hand side). This again follows the recommendation of Webster and Watson (2002) when investigating an emerging topic, which is valid given the limited availability of peer-reviewed literature. Grey literature includes

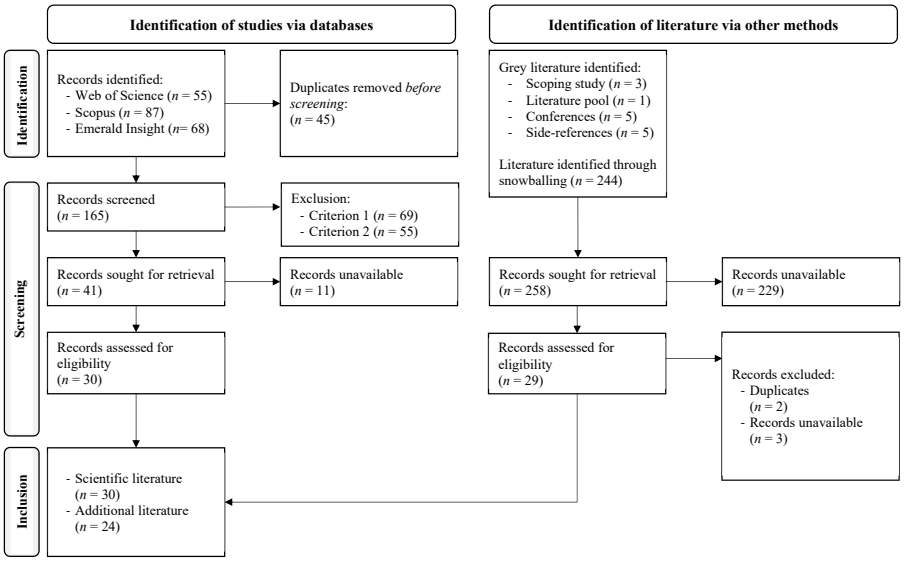

Figure 1. PRISMA flow chart. **Source(s)**: Authors' own work, based on Page *et al.* (2021)

reports and working papers identified during the scoping study, within the defined literature pool, through conferences attended and through their corresponding references. Snowballing is applied to all sources included in the literature pool, using the Web of Science cited reference search feature and Google Scholar. Nevertheless, a large share of the identified citations is excluded due to limited accessibility. Through this process, 24 additional sources are added, and a total of 54 studies are included in the systematic review.

The literature analysis adopts an inductive approach, developing a coding scheme that identifies common concepts and divergent perspectives. This process informs the results section.

4. Results

The investigated literature reveals a triad of concepts concerning how the financial sector can contribute to limiting biodiversity loss, namely (1) increasing awareness of biodiversity and its loss, (2) seizing emerging business opportunities and (3) enhancing biodiversity visibility through reporting. These pathways are presented in detail below.

4.1 Increasing biodiversity awareness and decreasing biodiversity-related risks

Van Toor *et al.* (2020) indicated that the impact of FIs on biodiversity is considerable. Examining the biodiversity footprint per Euro of turnover for the Dutch financial sector, they estimate it at approximately 58,000 square kilometres, around 1.7 times the Netherlands' land surface area. This assessment accounted for land use changes and greenhouse gas (GHG) emissions, capturing only part of biodiversity's complexity and its loss drivers. Consequently, the actual footprint is likely to be larger. Biodiversity loss has implications not only for human well-being but also poses various risks to FIs and the wider financial sector (Potdar *et al.*, 2016), which may disrupt financial systems (Dasgupta, 2021). Accordingly, FIs need to increase awareness of biodiversity and mainstream it among their clients, including understanding the multitude of indirect and direct biodiversity-related risks.

The financial sector must acknowledge the necessity of considering both the immediate economic dependencies on and impacts of biodiversity on FIs and the long-term projections of biodiversity loss to ensure the effective functioning of these institutions, which requires the application of a double materiality perspective (Schellekens and van Toor, 2019; van Toor *et al.*, 2020; World Wildlife Fund, 2021). In a restructured financial sector, economic growth should be pursued independently of societal and environmental degradation, thereby facilitating sustainable development in the long term (CISL, 2021; van Toor *et al.*, 2020; Ziolo *et al.*, 2019). This approach may mitigate the prevalence of greenwashing, as businesses seeking funding from FIs would be inclined to prioritise broader stakeholder outcomes rather than solely focusing on short-term shareholder gains (Chabrak, 2018).

FIs are exposed to a range of risks, which can be classified into direct and indirect biodiversity-related risks (Barker *et al.*, 2020; Clark *et al.*, 2018; Mulder and Koellner, 2011; NCC, 2018; Portfolio Earth, 2020; Schellekens and van Toor, 2019; van Toor *et al.*, 2020). These risks are critical to corporate decision-making processes (Dempsey, 2013; Loorbach *et al.*, 2020). Direct risks are associated with biodiversity degradation that has immediate implications for the operational functioning of FIs (Mulder and Koellner, 2011), resulting in financial risks (e.g. market or credit risk) (Schellekens and van Toor, 2019; van Toor *et al.*, 2020) as well as potential disruptions to business continuity if inadequately addressed (Clark *et al.*, 2018). Indirect risks arise from the activities of FIs that impact biodiversity and natural capital through their clients' operations, which subsequently alter the direct drivers of biodiversity loss (e.g. pollution, land-use change) (Ascui and Cojoianu, 2019; Mulder and Koellner, 2011). The main biodiversity-related risks identified for FIs are displayed in Table 2.

Assessing and estimating direct biodiversity-related risks is inherently complex and not yet standardised (Barker *et al.*, 2020). As a result, high-level lending requirements often focus on

Table 2. Direct and indirect biodiversity-related risks

Direct biodiversity-related risks	Indirect biodiversity-related risk
1. Reputational risks • Reputational threats arising from financing activities that adversely affect biodiversity 2. Liability risks • Biodiversity-related risk arising from remediation obligations, litigation, misassessment of ecosystem impacts, credit security depreciation and default risks 3. Transition/Regulatory risks • Risk of policy changes requiring adjustments to business practices or contracts	• Counterparty risk from business partners' biodiversity-related risks, including cost increases, contract breaches and credit defaults • Indirect biodiversity risk contingent on sectoral, regional and commodity exposure, with heightened vulnerability in biodiversity-dependent contexts

Source(s): Authors' own work, based on the reviewed literature

avoiding direct risks such as reputational risks by refraining from investing in certain business sectors, such as the mining industry, which can render specific risk valuations unnecessary (Ascui and Cojoianu, 2019). Indirect risks tend to be even more complex to assess because the influencing factors are broader, making precise estimation challenging (Ascui and Cojoianu, 2019). Consequently, FIs rely on sufficient biodiversity-related data from their business partners to estimate potential risks (Barker *et al.*, 2020; NCC, 2018; Schellekens and van Toor, 2019). However, biodiversity and ecosystem services are often viewed as public goods by the secondary and tertiary sectors, leading to insufficient attention and limited data availability (Bhattacharya and Managi, 2013; Krause *et al.*, 2021). This gap presents an opportunity for FIs to raise awareness across business sectors through their activities and formalised requirements.

4.2 Seizing emerging business opportunities

Although current biodiversity trends entail significant risks, framing biodiversity solely as a threat to the financial sector would be incomplete. With appropriate interventions, the opposite may be the case. Awareness of biodiversity-related risks can reveal significant business opportunities that need further investigation (Dempsey, 2013; Potdar *et al.*, 2016). The implementation of targeted corporate biodiversity management can yield immediate advantages for FIs, including reduced risks and associated costs, decreased liability and enhanced operational efficiency (Bhattacharya and Managi, 2013; Mejia-Escobar *et al.*, 2020; Mulder and Koellner, 2011; Platform on Sustainable Finance, 2021).

FIs and their clients' interconnectedness with biodiversity must be recognised to mitigate the potential for biodiversity-related risks to materialise. When such risks become material, they can translate into credit, liquidity, market and operational risks that threaten the overall functioning of FIs (CISL, 2021; Negra *et al.*, 2020; Schellekens and van Toor, 2019; van Toor *et al.*, 2020). Biodiversity loss notably heightens systemic risks for long-term yield-focused FIs, such as pension funds, thereby jeopardising both business operations and client returns (Mulder and Koellner, 2011). To address this issue, FIs could proactively seek biodiversity-related data from clients and investment opportunities (e.g. impacts and dependencies on biodiversity, corporate biodiversity data) for fostering biodiversity awareness (Ascui and Cojoianu, 2019; van Toor *et al.*, 2020) and use their leveraging power to induce positive biodiversity change (Krause *et al.*, 2021).

Figure 2 illustrates that restructuring the financial sector to incorporate the double materiality of biodiversity may lead to changes in both direct and indirect impacts and risks. Once innovative business approaches of FIs are implemented (as shown in the grey box with dashed arrows), a better alignment of short-term and long-term perspectives on biodiversity will alter the indirect risks and impacts. This change may also enhance the functioning of business partners, ultimately benefiting biodiversity.

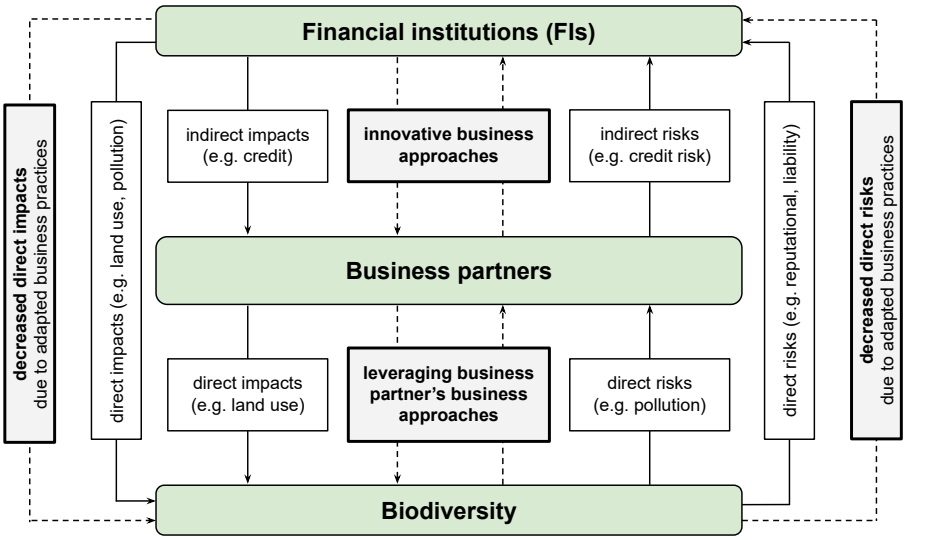

Figure 2. Altering biodiversity-related impacts and risks by restructuring the finance sector. **Source(s)**: Authors' own work, adapted from Mulder and Koellner (2011)

Biodiversity can be viewed as an opportunity for business reorientation and the adoption of sustainable leadership practices rather than as a burden for the financial sector. By doing so, it has the potential to mitigate prevailing impacts on biological diversity and positively influence the progress of the SDGs (CISL, 2021; Platform on Sustainable Finance, 2021). Figure 2 delineates the two ways in which FIs can alter impacts on biodiversity: (1) by transforming their direct relationship with biodiversity, thereby addressing their direct biodiversity footprint, and (2) by altering their business relationships, such as by implementing requirements for biodiversity-related investment disclosures, which facilitate a shift in indirect impacts on biodiversity and promote sustainable practices among business partners. Departing from conventional business practices enables FIs to identify opportunities that provide innovative solutions to natural resource scarcity, thereby supporting the emergence of new business models (Dempsey, 2013; Mulder and Koellner, 2011). This can represent a triple win for FIs, business partners and society at large, including the environment (Chabrak, 2018).

To effectively convert biodiversity-related risks into business opportunities, the financial sector would need to undergo a comprehensive restructuring of its operational framework (Portfolio Earth, 2020). The existing literature highlights the necessity of formulating a definition of biodiversity that is specifically tailored to the financial sector (Mulder and Koellner, 2011; NCC, 2018; Potdar *et al.*, 2016). The frequently referenced definition provided by the CBD (1992) is too generalised and fails to adequately reflect the specific industries, regions or commodities in which particular FIs engage. Establishing clear boundaries for assessing biodiversity within a FI (e.g. at the sectoral, regional, or commodity level) is a necessary first step (Addison *et al.*, 2020; de Silva *et al.*, 2019) and aligns with increasing biodiversity awareness. However, despite FIs' recognition of their impacts on biodiversity, a significant gap persists in their organisational responses to these challenges (Krause *et al.*, 2021; Mulder and Koellner, 2011; de Silva *et al.*, 2019).

Once a FI has established its definition and scope of biodiversity, several strategies can be employed to integrate biodiversity considerations within the financial sector. These strategies may include incorporating biodiversity aspects into due diligence assessments, formulating exclusion policies for investment and business decisions, establishing sector-specific

guidelines and enhancing credit scoring processes (Ascui and Cojoianu, 2019; Mulder and Koellner, 2011; Portfolio Earth, 2020; de Silva *et al.*, 2019; van Toor *et al.*, 2020; Turnhout *et al.*, 2021; Vazzano *et al.*, 2018). For instance, business exclusion lists, already a standard tool within the financial sector, could be expanded to reflect a biodiversity perspective. This enhancement may mitigate risks while increasing the reputational benefits for the FI, without requiring an overhaul of existing structures (Mulder and Koellner, 2011). Moreover, the literature indicates that FIs could broaden their existing analyses and operational activities to incorporate biodiversity considerations, thereby expanding established processes (van Toor *et al.*, 2020; Vazzano *et al.*, 2018) and effectively reconceptualising biodiversity risks as opportunities (Bigger *et al.*, 2021; Christiansen, 2021; Mulder and Koellner, 2011).

However, at first, FIs need to be able to identify investments and financing enquiries through the lens of biodiversity impacts and dependencies (Turnhout *et al.*, 2021). Mulder and Koellner (2011) suggest that FIs could collaborate closely with business partners to jointly reduce biodiversity decline. Additionally, requiring corporate business partners to implement biodiversity action plans can serve as a preventive measure against potential biodiversity-related risks (Mulder and Koellner, 2011; Schellekens and van Toor, 2019; van Toor *et al.*, 2020). By requiring these action plans, corporate business models can be enhanced, fostering the creation of innovative and sustainable business practices that support biodiversity (see Figure 2) (CISL, 2021; Mejia-Escobar *et al.*, 2020).

Including environmental aspects in lending decisions is not new. Numerous FIs have already incorporated such elements into scoring systems (Mulder and Koellner, 2011), often due to legal requirements (Ascui and Cojoianu, 2019). Therefore, further research is needed to systematically incorporate biodiversity matters into existing business processes to ultimately realise the full potential of biodiversity-related business opportunities.

4.3 Increasing biodiversity visibility through reporting

Understanding the economic significance of biodiversity reveals interconnected risks and opportunities for businesses. Prioritising and systematically reporting on biodiversity issues within the financial sector could catalyse substantial corporate action and redirect the private sector away from conventional linear business practices (Dempsey, 2013; Potdar *et al.*, 2016; Sustainable Finance Platform, 2020). Furthermore, reporting on biodiversity enhances its visibility, making it an essential aspect of communication with stakeholders and promoting awareness of biological diversity (Potdar *et al.*, 2016).

Existing literature provides limited insight into how the financial sector incorporates biodiversity issues into its reporting. For example, Bhattacharya and Managi (2013) perform a case study indicating that, except for financial securities companies, most of the investigated FIs do not report on biodiversity. A quantitative rating by Mulder and Koellner (2011) concludes that of 50 observed FIs, 51% acknowledged indirect impacts on biodiversity, while 49% failed to recognise the influence of biodiversity on their operational functions. In contrast, a quantitative content analysis investigating the biodiversity reporting in the private sector according to the Global Reporting Initiative (GRI) G3.1 guidelines states that the financial sector reached the maximum number among all sectors (Potdar *et al.*, 2016). Nevertheless, the authors focus on quantitative analysis and do not provide further information about the qualitative manifestation of the respective biodiversity indicators. Additionally, Ziolo *et al.* (2019) show that FIs incorporate biodiversity protection as a leading environmental criterion in integrating environmental, social and governance (ESG) factors into reporting and decision-making to increase the financial sector's sustainability. However, the authors do not outline how FIs report on biodiversity matters in the ESG context.

The diverse research designs and foci observed in the cited studies introduce a level of uncertainty regarding the comprehensiveness with which FIs report on this critical topic. Biodiversity considerations, respective indicators and key performance indicators are needed to safeguard the capacity of future economies to thrive. Growth across all forms of capital,

including natural capital, is necessary, and reporting on it is integral to guiding sustainable development (Chabrak, 2018; Schellekens and van Toor, 2019; Watson and Newton, 2018). As Milner-Gulland *et al.* (2021) argue, achieving a coordinated response to biodiversity loss requires increased and harmonised reporting practices among all actors. Numerous reporting frameworks and corresponding finance standards have been established to address environmental issues. These include the GRI, the Principles for Responsible Investment, the Equator Principles and the UN Global Compact, among others (Buteica and Huidumac-Petrescu, 2019; Chabrak, 2018; Mulder and Koellner, 2011; Zhagyparova *et al.*, 2019). Yet, most of these are non-binding and voluntary, which hinders the subsequent implementation of such reporting across the financial sector (Buteica and Huidumac-Petrescu, 2019).

Enhancing biodiversity reporting is essential for elevating its visibility, acknowledging its intrinsic values and refining management and decision-making processes (Clark *et al.*, 2018). Thus, FIs need to recognise biodiversity along with its interconnections to business success, advocate for robust measurement and reporting frameworks and adopt a long-term perspective on sustainable economic growth (Chabrak, 2018; Sustainable Finance Platform, 2020; UNDP, 2018; van Toor *et al.*, 2020).

5. Discussion

Although the literature on the topic remains limited, three main concepts regarding how the financial sector can contribute to mitigating biodiversity loss have emerged from the review. Contemporary scientific discourse identifies the financial sector as a key player in enhancing biodiversity awareness and facilitating a shift from the linear economic paradigm (Bigger *et al.*, 2021; Clark *et al.*, 2018; Loorbach *et al.*, 2020). However, the sector also exacerbates biodiversity degradation, largely due to insufficient recognition of biodiversity issues interconnected with specific business decisions (Bigger *et al.*, 2021; Dempsey, 2013, 2016; Husin *et al.*, 2018; de Silva *et al.*, 2019). To mitigate biodiversity loss, increasing awareness of its interconnected benefits is essential for shifting away from conventional business practices. Consequently, a hierarchy of concepts has emerged, prioritising biodiversity awareness as the foremost objective.

Biodiversity awareness is a key foundation for advancing business opportunities and enhancing biodiversity visibility. A FI is unlikely to elevate the significance of biodiversity without recognising the associated benefits and threats arising from its degradation. Without this awareness, the FI may fail to realise the full potential of biodiversity-related opportunities and thereby hinder positive change. Similarly, neglecting the material importance of biodiversity due to a lack of recognition can lead to underestimating the need for measurement and reporting. This oversight could contribute to further degradation of biodiversity through conventional business activities, potentially jeopardising the institution's viability. Therefore, fostering biodiversity awareness and engaging stakeholders are important for enhancing recognition among business partners, optimising reporting practices and mitigating biodiversity-related risks.

Efforts to address biodiversity loss are gaining traction. However, climate-related actions remain more accessible for FIs. This disparity arises from established reporting frameworks and measurement options, coupled with the complexities of quantifying biological diversity (de Silva *et al.*, 2019; Watson and Newton, 2018). To effectively support biodiversity restoration, the financial sector needs to recognise that all businesses rely on biodiversity, ecosystem services and natural capital (NCC, 2018; OECD, 2019). This directly influences the economic activities of FIs. Furthermore, the challenges of climate change and biodiversity loss are interrelated (Pascual *et al.*, 2022; Shin *et al.*, 2022), addressing one necessitates also addressing the other. A prevalent limitation in contemporary sustainability reporting is the omission of biodiversity reporting due to the lack of appropriate measures (Addison *et al.*, 2020; Milner-Gulland *et al.*, 2021; de Silva *et al.*, 2019; Smith *et al.*, 2020). As a result, the scientific community advocates further

research on biodiversity reporting to integrate suitable metrics into existing frameworks (Addison *et al.*, 2020; Smith *et al.*, 2020). Despite these challenges, initial efforts to incorporate biodiversity considerations into sustainability reporting are evident. For instance, the GRI has introduced biodiversity-related extensions within its principles (Potdar *et al.*, 2016). Moreover, FIs have increasingly incorporated biodiversity into their ESG frameworks, even prior to 2008 (Ziolo *et al.*, 2019).

The integration of biodiversity considerations within FIs remains ambiguous. Future research should therefore investigate the implementation of biodiversity in the financial sector. While this study offers valuable insights into the financial sector's influence on biodiversity, it lacks comprehensiveness due to its restricted focus on the financial sector and publications from 2010 to 2021. Additionally, it overlooks other influential actors within the financial system. This highlights the need for further investigation, particularly considering policy actions that compel FIs to respond. Further, the article also overlooks additional actors shaping the functioning of the financial system. This creates another starting point for future investigations into how stakeholder pressures drive biodiversity actions of FIs. Moreover, the exclusion of the consumption side overlooks the role of financial service consumers, who may significantly affect the sector's functioning. Future research should therefore explore the impacts of consumer behaviour on the financial sector's biodiversity outcomes. This could be examined using established consumer psychology theories, such as the theory of planned behaviour.

This study underscores the essential role of FIs and the financial sector in mitigating ongoing biodiversity loss. Addressing biodiversity loss while capitalising on business opportunities presents a triple benefit for FIs, society and biological diversity (Chabrak, 2018), which warrants further research. This is crucial for meeting the objectives outlined in the CBD's post-2020 framework (CBD, 2022), particularly in light of the limited effectiveness of previous initiatives.

6. Conclusion

This work aims to clarify the financial sector's critical role in addressing the ongoing loss of biodiversity. It highlights three key pathways for promoting biodiversity restoration. Despite this potential, the financial sector tends to neglect its role in supporting the mitigation of biodiversity degradation and often regards biodiversity as immaterial, which hampers awareness and effective decision-making.

Since the 2008 financial crisis, there has been a growing emphasis on sustainability within finance, driven by the need to increase resilience and prevent future crises. Operationalising biodiversity into clear definitions and measurement options is important for integrating it into FIs' sustainability strategies and business operations. Unfortunately, biodiversity is often treated as a secondary concern compared to climate change, leading to insufficient corporate accountability and progress toward biodiversity protection. Addressing both crises together is crucial for ensuring future human well-being.

Recognising the interconnectedness of biodiversity and the economy is vital. The next decade is critical for shaping our relationship with nature and securing livelihoods. While concepts promoting biodiversity inclusion in finance are emerging, they require further exploration. This work provides new insights by laying a foundation for further research, mainstreaming biodiversity and identifying three clear pathways to facilitate actions within and beyond the financial sector.

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Corresponding author
Lisa Junge can be contacted at: lisa.junge@tu-dresden.de